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Monthly Performance Report

IRVINE SCHOOL

JUNE 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT
IRVINE SCHOOL
JUNE 1979

I. SYSTEM DESCRIPTION

The El Camino Real Elementary School, referred to hereafter as Irvine School, is located in Central Orange County, California. The school is approximately ten miles from the Pacific Ocean, and was built in 1971. The building contains 41,109 square feet of floor area, and is normally occupied five days a week by 850 children and 60 adults. Building occupancy is uniform throughout the year since the school operates on a trimester plan. The solar energy system was added to the existing building, and was designed to supply 50 percent of the annual building heating and cooling demand.

The solar energy installation includes 4,950 square feet of evacuated tubular glass collectors, a heat rejector, and a heat exchanger from the collector loop to the load loop. The collector array faces south at an angle of 25 degrees from the horizontal. Water is used as the medium for delivering solar energy from the collector array to the heat exchanger for transfer to the load subsystems. Existing load loop components were unaltered except for controls. These load loop components include a 4-million Btu per hour boiler, two 100-ton absorption chillers, 41 heating coils, and seven air handlers. Since heating demands are low due to the moderate climate and most of the load demand occurs during the day, no solar energy storage is provided. The collected solar energy is transferred directly from the collector loop to the load loop via the heat exchanger. If collected energy exceeds the load loop demand, excess energy is rejected via the heat rejector. The heat rejector is a water-to-air heat exchanger mounted on the roof and situated in the collector loop between the collector outlet and the load loop heat exchanger inlet. If the solar energy does not meet the full energy demand from the loads, the boiler is activated to make up the shortage before the hot water

reaches the loads. The hot water is routed to the chillers or heating coils, or both, depending on the building demand. The hot water then returns to the heat exchanger to complete the cycle.

The system, shown schematically in Figure 1, has five modes of solar operation.

Mode 1 - Collector Protection: This mode occurs when the lower flow capacity (15 GPM) auxiliary collector pumps are turned on by a clock timer. This is normally before collection begins and is required to precondition the collectors for main pump flow and ambient temperature conditions. This mode is reentered daily at the completion of mode 2 operation, and is subsequently terminated by the clock timer. Since no other freeze protection subsystem is provided, this mode is also entered when the outside ambient temperature is less than 38°F. The clock controller is overridden for freeze protection entry when this control temperature has been reached.

Mode 2 - Solar Energy Collection: This mode occurs when the main collector pump (125 GPM) is on. Mode entry requires a differential temperature of 15°F between the collector outlet and the load side inlet to the heat exchanger. When the differential temperature again drops below 15°F (adjustable), mode 1 is reentered.

Mode 3 - Collector-to-Space Heating/Cooling: In this mode, heating and cooling loads may be active at the same time. This mode is enabled at all times, and receives energy from the solar energy system when available. If solar energy is not available, or is insufficient to satisfy the full demand, the auxiliary boiler is activated to supply the remaining demand. At night, this mode is normally disabled by the clock timer.

Mode 4 - Solar Heat Rejection: This mode occurs when excess solar energy is diverted from the collector loop and rejected to the environment

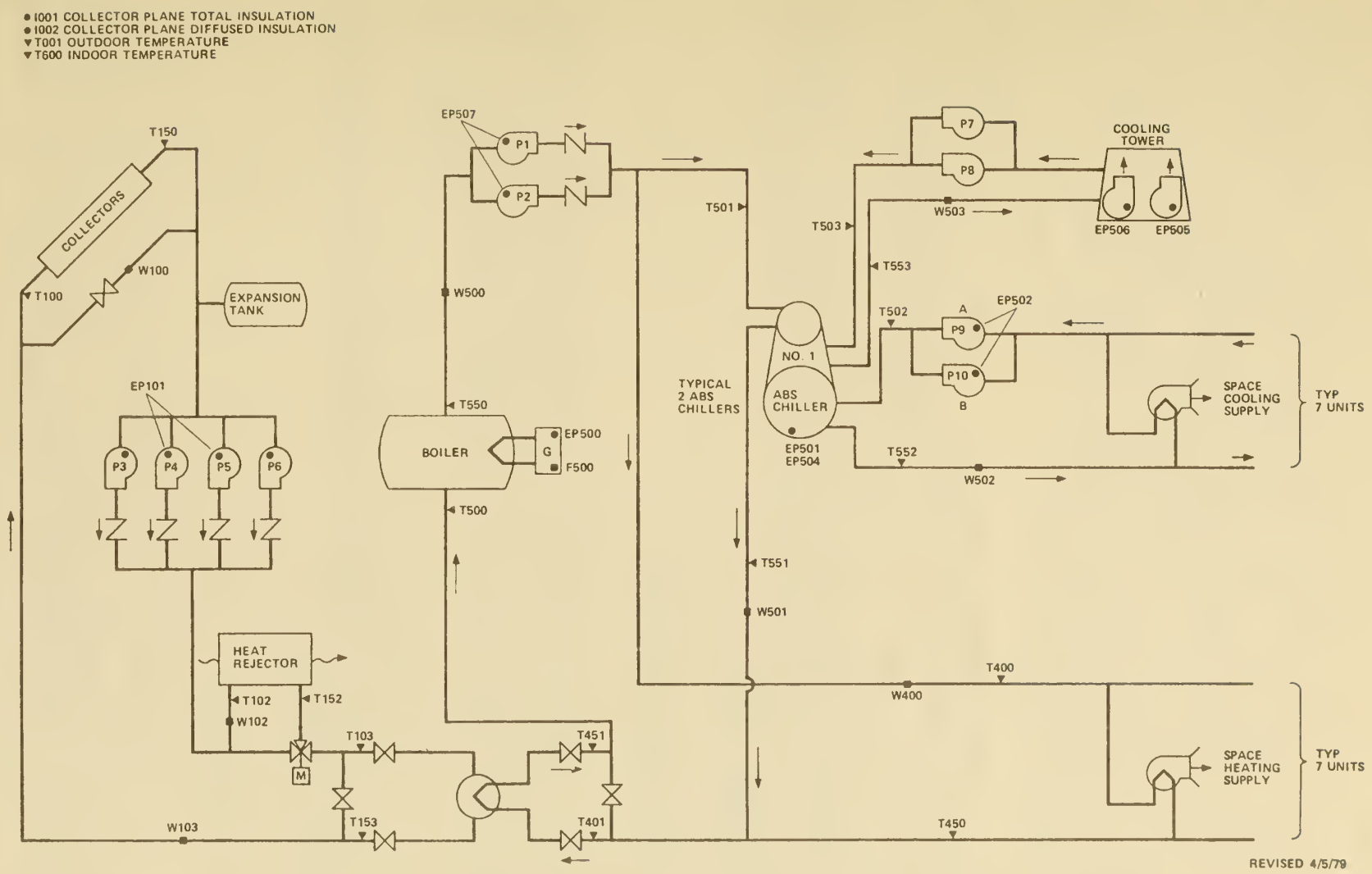

Figure 1. IRVINE SCHOOL SOLAR ENERGY SYSTEM SCHEMATIC

through a liquid-to-air heat exchanger on the roof. This mode is entered if the temperature at the collector loop outlet from the heat exchanger exceeds a variable set point (approximately 215°F). Upon exceeding this set point temperature, a three-way valve is switched to initiate collector loop flow through the heat rejector, and the heat rejector fan is turned on to increase the air flow across its coils. When the heat exchanger outlet temperature drops below another variable set point (approximately 200°F), the three-way valve is reversed, the heat rejector fan is turned off, and this mode is terminated.

Mode 5 - Collector Backup Protection: This mode is entered when the collector outlet temperature exceeds a set point (approximately 220°F). Control design assumes the collector pumps are not operating if this temperature is exceeded. In this mode, normally open solenoid valves allow city supply water to enter the collectors and drain out at the collector outlet. This mode protects against collector thermal shock damage if a power outage occurs.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The solar energy system at Irvine School operated continuously during June except on the 20th. It satisfied 20 percent of the combined space heating and cooling energy requirements. By design, the system performed heating and cooling simultaneously for different areas of the building. The space cooling requirements were 96 percent of the total system load.

B. Weather

Due to the year-round mild outside ambient temperatures in the Irvine School area, simultaneous heating demand and cooling demand is not unusual. In comparison to an expected average outside ambient temperature of 64°F, the actual outside ambient temperature averaged 72°F during the month. The daytime ambient temperature during the 9:00 a.m. to 3:00 p.m. hours averaged 84°F. The measured insolation in the plane of the collectors averaged 1,886 Btu/ft^2-day, below the expected long-term average of 2,002 Btu/ft^2-day which was derived from measurements taken at the Los Angeles International Airport, California.

C. System Thermal Performance

Collector - Of the 289.59 million Btu of solar energy incident on the collector array during June, 271.32 million Btu were incident on the collector array when there was fluid circulating in the collector loop. The system collected 109.57 million Btu of solar energy, or 38 percent of the total incident insolation on the collector array. In this solar energy system, collected energy is either delivered to the load or rejected through the heat rejector. No storage of energy is provided. During June, 21.25 million Btu of energy were rejected by the heat rejector in the collector-to-load loop, resulting in a net collection of 88.32 million Btu of energy. An additional 19.20 million Btu of heat energy was rejected by the collector itself during the period of low insolation.

Space Heating - The outside ambient temperatures during June were low enough to require some heating of the building during only 8 days of the month. The resulting heating load was 6.55 million Btu. The heating subsystem utilized 0.80 million Btu of solar energy, and 6.48 million Btu of auxiliary energy. The resulting solar fraction for space heating is 8.8 percent. The operating energy of the space heating subsystem was 0.70 million Btu.

Space Cooling - The space cooling subsystem was used every day in the month of June. The space cooling load was 144.78 million Btu. There was 77.06

million Btu of solar energy used, and 400.15 million Btu of auxiliary energy used for space cooling. The sum of the solar and auxiliary energies used was 477.21 million Btu, which supported the space cooling load through the absorption chillers. The resulting solar fraction for space cooling is 21 percent, and the operating energy of the space cooling subsystem during June was 78.30 million Btu.

D. Observations

During June, 21.34 million Btu of auxiliary energy was delivered from the load loop, through the heat exchanger, to the collector loop. This occurred in both the early morning and late evening when both the auxiliary boiler and solar collectors had their pumps on. During these same times, the collectors lost 19.20 million Btu. In the month of June, the Irvine area experienced many warm days but temperatures dropped rapidly in the late afternoon. Typically, nighttime temperatures range in the low to mid sixty's. Once the solar insolation gets down to a low level in the afternoon, the collectors become net rejectors of thermal energy and the collector loop becomes a drain on the auxiliary system. This is, of course, just the opposite of what the system was designed to perform.

The collectors have two sets of pumps; the main pumps and a smaller set whose design purpose was to bring the collector tubes up to operating temperature slowly to protect from thermal shock. These small pumps did not work as planned. This aggravated the collector loss problem by not moderating the flow rates during times of high loss. Collector and auxiliary systems typically come on by timer at 5:15 a.m. and go off at 8:00 p.m.

Analysis indicates that the collectors do not, as previously supposed, contribute energy to the load side of the heat exchanger early in the morning. When the auxiliary boiler is turned on before the collector pumps, as was the case in June, the temperature of the water from the collectors is too low, in comparison to the load side, for the heat exchanger to pass energy in the collector to load direction.

The heat loss problems through the collector do not indicate a poor design, but they are a function of the system controllers. The collectors are working relatively well when operated during periods of significant solar insolation.

Irvine School is a large building with few windows. It contains 41,109 square feet of floor area, and is normally occupied by 910 people. Considering the climate of Orange County, buildings of this type generally require heating and cooling during most months. The heating and cooling system at Irvine School is designed to operate simultaneously when necessary. There are seven separate zones in the building which are heated or cooled. The current philosophy does not permit thermal analysis of each zone separately. Therefore, the data in the space heating and space cooling subsections of the attached report refer to the combined cooling or combined heating requirements for the entire school.

Similarly, the inside ambient air temperature defined in the space heating and space cooling subsections of the attached report does not reflect the average temperature for all zones, but represents the average inside ambient air temperature in the area of the sensor.

It should be noted in passing that inside temperature consistently rose during the night while the chillers were not operating. At the same time, outside ambient temperature dropped into the 60 - 70°F range, or even lower. Like many buildings constructed during the same period as Irvine School, no provision is made to take advantage of this source of natural cooling.

Irvine School has two very large capacity (100 ton) absorption chillers which often experience low efficiencies when underloaded. In June the average daily values of the Coefficient of Performance (COP) for the absorption chillers ranged from a low of 0.16 to a high of 0.54. The average COP was 0.32. These figures are much improved from the months before and are attributable to the higher daytime temperatures.

An estimated value of 15 kw was used for power consumption of the pumps in the cooling tower loop, since these pumps are uninstrumented.

E. Energy Savings

The Irvine School solar energy system resulted in a fossil fuel savings of 129.76 million Btu at an operating expense of 10.80 million Btu of electrical energy. Converting the electrical energy to a fossil equivalent yields 36.00 million Btu of operating energy. Therefore, the net fossil savings was 93.76 million Btu. The fossil energy savings calculations are based on a comparison of the projected energy requirements of a conventional, fossil energy boiler, with an efficiency of 60 percent, and the energy requirements of the solar energy system.

III. ACTION STATUS

All sensors associated with the absorption chiller operation are being recalibrated to correct a small energy imbalance observed in its operation.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/06
REPORT PERIOD: JUNE,1979

SITE/SYSTEM DESCRIPTION:
THE SOLAR ENERGY SYSTEM WILL AUGMENT THE EXISTING HEATING AND COOLING SYSTEM BY PROVIDING HEATED WATER FOR ABSORPTION CHILLERS AND BUILDING HEAT. SOLAR ENERGY IS COLLECTED BY BANKS OF EVACUATED GLASS TUBE COLLECTORS AND TRANSFERRED TO THE LOADS VIA A HEAT EXCHANGER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	289.592	MILLION BTU
	58503	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	109.574	MILLION BTU
	22136	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	72	DEGREES F
AVERAGE BUILDING TEMPERATURE	79	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.27	
ECSS OPERATING ENERGY	10.802	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	89.809	MILLION BTU
TOTAL ENERGY CONSUMED	738.540	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL	
LOAD	N.A.	6.551	144.784	151.335	MILLION BTU
SOLAR FRACTION	N.A.	9	21	20	PERCENT
SOLAR ENERGY USED	N.A.	0.796	77.058	78.066	MILLION BTU
OPERATING ENERGY	N.A.	0.704	78.303	89.809	MILLION BTU
AUX. THERMAL ENERGY	N.A.	6.483	400.145	413.978	MILLION BTU
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A.	MILLION BTU
AUX. FOSSIL FUEL	N.A.	10.578	524.865	539.158	MILLION BTU
ELECTRICAL SAVINGS	N.A.	N.A.	0.000	-10.802	MILLION BTU
FOSSIL SAVINGS	N.A.	1.327	128.431	129.757	MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.181

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/06
REPORT PERIOD: JUNE,1979

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THE SOLAR ENERGY SYSTEM WILL AUGMENT THE EXISTING HEATING AND COOLING SYSTEM BY PROVIDING HEATED WATER FOR ABSORPTION CHILLERS AND BUILDING HEAT. SOLAR ENERGY IS COLLECTED BY BANKS OF EVACUATED GLASS TUBE COLLECTORS AND TRANSFERRED TO THE LOADS VIA A HEAT EXCHANGER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	305.519	GIGA JOULES
	664366	KJ/SQ.M.
COLLECTED SOLAR ENERGY	115.601	GIGA JOULES
	251379	KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	22	DEGREES C
AVERAGE BUILDING TEMPERATURE	26	DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.27	
ECSS OPERATING ENERGY	11.396	GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	94.748	GIGA JOULES
TOTAL ENERGY CONSUMED	779.159	GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL	
LOAD	N.A.	6.911	152.747	159.659	GIGA JOULES
SOLAR FRACTION	N.A.	9	21	20	PERCENT
SOLAR ENERGY USED	N.A.	0.840	81.296	82.359	GIGA JOULES
OPERATING ENERGY	N.A.	0.743	82.609	94.748	GIGA JOULES
AUX. THERMAL ENG	N.A.	6.839	422.153	436.746	GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A.	GIGA JOULES
AUX. FOSSIL FUEL	N.A.	11.160	553.732	568.811	GIGA JOULES
ELECTRICAL SAVINGS	N.A.	N.A.	0.000	-11.396	GIGA JOULES
FOSSIL SAVINGS	N.A.	1.400	135.494	136.894	GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.181

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
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REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: IRVINE SCHOOL IRVINE CALIFORNIA
REPORT PERIOD: JUNE,1979

SOLAR/2021-79/06

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	9.788	69	3.932	1.209	0.404	0.484	0.388
2	5.313	68	0.000	0.000	0.427	0.000	0.000
3	8.810	69	0.000	0.000	0.438	2.296	0.000
4	5.765	68	2.700	1.281	0.436	0.000	0.394
5	4.745	68	2.227	1.176	0.444	0.000	0.357
6	2.810	65	1.177	1.495	0.416	0.000	0.181
7	2.579	65	1.061	1.521	0.419	0.000	0.209
8	11.458	72	5.499	0.810	0.411	0.000	0.426
9	11.735	79	0.000	0.000	0.432	2.538	0.000
10	11.865	86	0.000	0.000	0.424	3.153	0.000
11	9.568	84	4.606	0.647	0.409	0.000	0.440
12	11.030	85	5.685	0.814	0.440	0.000	0.450
13	11.191	82	6.101	1.155	0.420	0.000	0.460
14	11.858	74	5.546	0.970	0.419	0.000	0.418
15	11.790	71	5.467	0.133	0.399	0.110	0.425
16	11.506	71	0.000	0.000	0.410	3.123	0.000
17	5.565	65	0.513	1.313	0.413	0.918	0.073
18	11.174	68	5.190	1.098	0.412	0.000	0.409
19	11.217	70	4.993	0.779	0.319	0.000	0.410
20	11.181	68	1.329	0.126	0.015	0.000	0.000
21	13.000	71	4.576	1.820	0.307	0.248	0.313
22	10.818	70	4.888	0.916	0.290	0.000	0.379
23	10.665	69	0.000	0.000	0.301	2.635	0.000
24	7.198	68	0.655	0.950	0.282	2.356	0.046
25	10.079	72	4.551	1.014	0.306	0.000	0.387
26	10.922	75	5.127	0.227	0.306	0.000	0.417
27	11.611	78	6.521	0.836	0.319	0.108	0.426
28	11.506	75	7.054	0.283	0.304	0.000	0.436
29	11.208	75	4.416	0.764	0.297	0.432	0.322
30	11.637	74	0.000	0.000	0.183	2.848	0.000
SUM	289.592	-	93.815	21.338	10.802	21.250	-
AVG	9.653	72	3.127	0.711	0.360	0.708	0.270
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	9.788	9.788	4.047	78	0.413
2	5.313	5.313	1.049	75	0.197
3	8.810	8.810	2.939	80	0.334
4	5.765	5.765	2.754	75	0.478
5	4.745	4.745	1.940	75	0.409
6	2.810	2.810	0.660	68	0.235
7	2.579	2.574	0.866	68	0.336
8	11.458	11.425	5.005	84	0.437
9	11.735	11.735	4.644	98	0.396
10	11.865	11.787	4.531	105	0.382
11	9.568	9.566	4.602	*	0.481
12	11.030	11.023	5.138	103	0.466
13	11.191	11.182	5.214	96	0.466
14	11.858	11.858	5.287	88	0.446
15	11.790	11.749	5.236	86	0.444
16	11.506	11.506	4.128	80	0.359
17	5.565	5.565	1.690	70	0.304
18	11.174	11.174	4.787	78	0.428
19	11.217	10.833	4.723	84	0.421
20	11.181	0.025	0.000	80	0.000
21	13.000	12.106	4.335	80	0.333
22	10.818	10.542	4.120	81	0.381
23	10.665	10.378	3.261	81	0.306
24	7.198	6.892	2.050	*	0.285
25	10.079	9.780	3.913	84	0.388
26	10.922	10.586	4.644	87	0.425
27	11.611	11.433	4.944	93	0.426
28	11.506	11.211	5.086	90	0.442
29	11.208	10.905	4.276	88	0.382
30	11.637	8.256	3.706	87	0.318
SUM	289.592	271.321	109.574	-	-
AVG	9.653	9.044	3.652	84	0.378
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: IRVINE SCHOOL IRVINE CALIFORNIA
REPORT PERIOD: JUNE,1979

SOLAR/2021-79/06

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.689	14	0.180	0.178	0.794	N	1.643	N	0.300	78	69
2	0.000	0	0.000	0.000	0.000	O	0.000	O	0.000	78	68
3	0.000	0	0.000	0.000	0.000	T	0.000	T	0.000	76	69
4	0.661	10	0.070	0.040	0.609		0.954		0.117	77	68
5	0.815	7	0.058	0.047	0.748	A	1.109	A	0.096	77	68
6	1.278	2	0.029	0.079	1.249	P	1.851	P	0.048	76	65
7	1.577	2	0.039	0.115	1.606	P	2.712	P	0.065	76	65
8	1.271	18	0.365	0.229	1.264	L	1.976	L	0.609	78	72
9	0.000	0	0.000	0.000	0.000	I	0.000	I	0.000	79	79
10	0.000	0	0.000	0.000	0.000	C	0.000	C	0.000	83	86
11	0.105	4	0.004	0.008	0.102	A	0.209	A	0.007	82	84
12	0.137	31	0.045	0.008	0.099	B	0.108	B	0.075	82	85
13	0.000	0	0.000	0.000	0.000	L	0.000	L	0.000	81	82
14	0.000	0	0.000	0.000	0.000	E	0.000	E	0.000	79	74
15	0.000	0	0.000	0.000	0.000		0.000		0.000	79	71
16	0.000	0	0.000	0.000	0.000		0.000		0.000	80	71
17	0.000	0	0.000	0.000	0.000		0.000		0.000	76	65
18	0.018	34	0.006	0.001	0.012		0.016		0.011	76	68
19	0.000	0	0.000	0.000	0.000		0.000		0.000	77	70
20	0.000	0	0.000	0.000	0.000		0.000		0.000	77	68
21	0.000	0	0.000	0.000	0.000		0.000		0.000	78	71
22	0.000	0	0.000	0.000	0.000		0.000		0.000	78	70
23	0.000	0	0.000	0.000	0.000		0.000		0.000	79	69
24	0.000	0	0.000	0.000	0.000		0.000		0.000	78	68
25	0.000	0	0.000	0.000	0.000		0.000		0.000	78	72
26	0.000	0	0.000	0.000	0.000		0.000		0.000	79	75
27	0.000	0	0.000	0.000	0.000		0.000		0.000	78	78
28	0.000	0	0.000	0.000	0.000		0.000		0.000	77	75
29	0.000	0	0.000	0.000	0.000		0.000		0.000	79	75
30	0.000	0	0.000	0.000	0.000		0.000		0.000	84	74
SUM	6.551	-	0.796	0.704	6.483	N.A.	10.578	N.A.	1.327	-	-
AVG	0.218	9	0.027	0.023	0.216	N.A.	0.353	N.A.	0.044	79	72
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE COOLING SUBSYSTEM

SITE: IRVINE SCHOOL IRVINE CALIFORNIA
REPORT PERIOD: JUNE,1979

SOLAR/2021-79/06

DAY OF MON.	SPACE COOLING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG DRY BULB TEMP F	AMB TEMP DEG F
1	5.215	24	3.615	2.747	13.457	N	19.018	0.000	6.024	78	69
2	-0.003	0	0.000	1.237	0.000	O	0.000	0.000	0.000	78	68
3	0.045	0	0.000	1.238	0.000	T	0.000	0.000	0.000	76	69
4	4.602	13	2.201	2.784	16.583		23.097	0.000	3.668	77	68
5	5.260	9	1.636	2.789	17.346	A	23.925	0.000	2.727	77	68
6	4.546	3	0.480	2.872	18.855	P	25.349	0.000	0.801	76	65
7	4.549	3	0.501	2.879	18.382	P	24.762	0.000	0.834	76	65
8	5.761	28	4.511	3.295	13.265	L	17.403	0.000	7.519	78	72
9	0.044	0	0.000	1.235	0.000	I	0.000	0.000	0.000	79	79
10	0.087	0	0.000	1.236	0.000	C	0.000	0.000	0.000	83	86
11	8.822	30	4.203	3.141	11.485	A	15.701	0.000	7.005	82	84
12	8.702	29	4.922	3.240	14.166	B	18.158	0.000	8.204	82	85
13	11.065	22	5.148	4.207	20.311	L	26.241	0.000	8.580	81	82
14	8.124	25	4.955	3.730	18.738	E	24.806	0.000	8.258	79	74
15	6.240	29	4.972	2.744	14.742		17.945	0.000	8.287	79	71
16	0.003	0	0.000	0.007	0.000		0.000	0.000	0.000	80	71
17	1.586	4	0.365	1.240	9.153		13.864	0.000	0.609	76	65
18	5.257	26	4.528	2.620	14.570		19.853	0.000	7.547	76	68
19	5.857	27	4.595	2.877	15.075		20.097	0.000	7.658	77	70
20	6.247	0	0.000	3.092	22.713		28.216	0.000	0.000	77	68
21	6.623	22	4.068	3.366	20.058		27.385	0.000	6.781	78	71
22	5.948	24	4.063	2.551	14.662		19.124	0.000	6.772	78	70
23	0.004	0	0.000	0.006	0.000		0.000	0.000	0.000	79	69
24	1.638	2	0.272	1.397	10.591		14.689	0.000	0.454	78	68
25	6.379	22	3.905	2.991	15.501		20.938	0.000	6.509	78	72
26	6.929	26	4.558	3.090	15.804		20.015	0.000	7.597	79	75
27	10.203	19	4.941	4.981	27.989		34.815	0.000	8.235	78	78
28	9.238	20	5.011	5.848	37.418		44.904	0.000	8.352	77	75
29	5.412	26	3.606	4.080	19.281		24.562	0.000	6.010	79	75
30	0.391	0	0.000	0.783	0.000		0.000	0.000	0.000	84	74
SUM	144.784	-	77.058	78.303	400.145	N.A.	524.865	0.000	128.431	-	-
AVG	4.826	21	2.569	2.610	13.338	N.A.	17.495	0.000	4.281	79	72
NBS	Q502	N500	Q500	Q503	Q501		Q508	Q512	Q514	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: IRVINE SCHOOL IRVINE CALIFORNIA
REPORT PERIOD: JUNE,1979

SOLAR/2021-79/06

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1977	888	69	78	N	N	N
2	1073	831	68	75	O	O	O
3	1780	816	69	80	T	T	T
4	1165	735	68	75			
5	959	834	68	75	A	A	A
6	568	490	65	68	P	P	P
7	521	462	65	68	P	P	P
8	2315	412	72	84	L	L	L
9	2371	315	79	98	I	I	I
10	2397	275	86	105	C	C	C
11	1933	308	84	*	A	A	A
12	2228	370	85	103	B	B	B
13	2261	307	82	96	L	L	L
14	2395	289	74	88	E	E	E
15	2382	330	71	86			
16	2325	527	71	80			
17	1124	826	65	70			
18	2257	597	68	78			
19	2266	423	70	84			
20	2259	472	68	80			
21	2526	608	71	80			
22	2185	429	70	81			
23	2155	483	69	81			
24	1454	678	68	*			
25	2036	785	72	84			
26	2206	560	75	87			
27	2346	314	78	93			
28	2324	390	75	90			
29	2264	443	75	88			
30	2351	363	74	87			
SUM	58503	15558	-	-	-	-	-
AVG	1950	519	72	84	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
THERMODYNAMIC CONVERSION EQUIPMENT

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	5.215	17.538	1.787	24.431	0.297
2	0.003	0.000	1.237	2.579	0.000
3	0.045	0.000	1.238	3.980	0.000
4	4.602	18.319	1.776	24.306	0.251
5	5.260	19.152	1.775	26.378	0.275
6	4.546	19.371	1.784	23.579	0.235
7	4.549	18.571	1.812	23.457	0.245
8	5.761	17.475	2.310	23.744	0.330
9	0.044	0.000	1.235	3.199	0.000
10	0.087	0.000	1.236	6.475	0.000
11	8.822	16.334	2.260	25.197	0.540
12	8.702	17.348	2.172	24.711	0.502
13	11.065	24.470	2.689	31.406	0.453
14	8.124	23.331	2.328	28.939	0.348
15	6.240	18.654	1.683	21.846	0.335
16	0.003	0.000	0.007	0.000	0.000
17	1.586	9.194	0.622	9.010	0.173
18	5.257	18.647	1.513	22.010	0.282
19	5.857	18.531	1.748	22.775	0.316
20	6.247	20.450	1.830	24.058	0.305
21	6.623	22.642	1.947	26.531	0.293
22	5.948	18.194	1.490	21.316	0.327
23	0.004	0.000	0.006	0.000	0.000
24	1.638	10.215	0.754	10.571	0.160
25	6.379	18.617	1.880	23.237	0.343
26	6.929	18.683	1.959	23.434	0.371
27	10.203	30.984	3.118	37.189	0.329
28	9.238	40.149	3.555	43.275	0.230
29	5.412	22.419	2.678	24.725	0.241
30	0.391	0.000	0.783	0.146	0.000
SUM	144.784	459.287	51.210	582.500	0.315
AVG	4.826	15.310	1.707	19.417	0.011

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NOTE:

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